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United States Department of the Interior
Fish and Wildlife Service

Fishery Leaflet 102

Chicago 54, Ill. * Revised December 1944

FROG CULTURE AND THE FROG INDUSTRY 1/

Prepared in the Division of Fishery Biology

While there may be considerable profit from the marketing of frogs, success in artificial propagation on a commercial scale still awaits realization, and such an undertaking, therefore, should be regarded as strictly experimental. Within the past 20 years the Fish and Wildlife Service has received thousands of inquiries concerning frog raising, but to the present time it has heard of only about three persons or institutions claiming any degree of success, so far as intensive frog culture is concerned. The Fish and Wildlife Service has never engaged in frog culture and can offer little first-hand information on the subject; neither has it nor any other branch of the Government ever distributed or sold frogs, tadpoles, or frog eggs.

FROG FARMING

Most of the so-called frog farms, and those which are least expensive and which require the least labor, are simply natural marshy areas or ponds adapted as to food supply and environment to the needs of frogs. In such areas the frogs, left to themselves, will thrive and multiply, but better results may be obtained by following some of the suggestions for increasing the shore-line, made in the article on "Principles of Bullfrog Culture," cited farther on and from which much of the following information on culture and pond construction is taken.

Any pond or swampy area may be stocked with adult frogs; or eggs may be collected for stocking purposes. In stocking waters with adults better results may, perhaps, be obtained by introducing the frogs into their new quarters in late summer and fall in order that they may become accustomed to their surroundings before the egg-laying season which usually begins in April in the Gulf States and in May or June farther north. It reaches its height in May and June in the South and in July in the North. In California certain species begin breeding in January and February. Smaller species might be hatched advantageously to serve as food for the larger edible varieties, but the cannibalistic habit which this suggests dictates a segregation of the commercial species according to size to prevent their eating one another.

While frogs lay their eggs in ponds and the tadpoles live in ponds, young and adult frogs spend most of their time in summer on the shore, hiding among vegetation, watching for their prey. Ample shore-line is important, but a large pond is not essential. The larger the pond, the less shore-line in proportion to area and comparatively fewer frogs can be accommodated. To increase the shore-line, therefore, and to make it as irregular as possible, it has been suggested that finger-like bays be dug, using the earth so obtained to make long peninsulas; also, that round, irregular islands may be made, or horseshoe-shaped units, or long narrow ponds, according to the natural accommodation of the land to the purpose. If no such natural area is available the whole project then can be arranged along the most suitable lines, and in this circumstance the construction of a series of hills and ditches running preferably in a north-south direction inside the selected area is recommended; this system gives greater length of shore line than any other shape of pond suitable for frog culture, and the north-south trend of the ditches provides shade when vegetation takes possession of the banks, which is a vital element in the well-being of frogs during the hot days of summer. In constructing a frog pond, select an area where the soil is capable of holding water, where a cheap supply of good water is obtainable, and good drainage exists.

In many sections of the South, rice fields offer a locale suited to frog farming and it has been suggested that the raising of muskrats and frogs might be combined to advantage. Willows and other shade trees should be planted along the banks and the water should not be deeper than is necessary to protect frogs and tadpoles from heat in summer and from freezing in winter; the depth would vary according to climatic conditions. Much shallow water 2 to 6 inches deep is essential as the small animals the frogs consume as food thrive best there and the frogs catch them more easily in shallow water. If sufficient shade is provided, 12 to 18 inches of water is deep enough in the southern section of the United States; in the North a certain part of the pond may be deepened to make safe hibernation quarters; for in winter frogs seek deep water or bury themselves in mud.

1/ This leaflet supersedes Memorandum I-2, issued by the former Bureau of Fisheries.

In any area designed for frog raising, game fish such as black bass, pikes, and pickerel, and snakes, snapping turtles, cats and foxes, and other enemies should be excluded, while encouragement should be given to minnows, crayfish, water-bugs and smaller species of frogs. Water birds also are destructive of frogs, and about the only way to exclude them in small areas would be to stretch a wire net above the water occupied by the frogs. The larger frogs will devour small turtles of about 2 inches diameter, and any fishes 3 to 4 inches in length.

If practicable a close-meshed fence about 3 feet high, topped with 1-inch meshed wire, about 18 inches wide, set on an outward incline of about 35 degrees, may be built around small ponds and pools to prevent undesirable frogs, toads, and other enemies from entering; by reversing the arrangement, the wire-topped fence may be used to prevent escape of the frogs.

FROG FARMING ABROAD

In some foreign countries where land is at a premium and labor cheap, frogs are reared in very small ponds, varying from 10 to 25 feet square, with as little as two or three square feet of space allowed for each large frog, and less for the young ones, with the different sizes separated to prevent cannibalism. In America, where land is cheap and wages high, it is believed that such intensive culture such as that followed in Japan could not be made profitable as a general rule, and that some compromise between the two extremes (natural swamps and intensive culture) may be devised to solve the problem. The degree of intensity would depend upon circumstances in each particular case.

ARTIFICIAL FEEDING

The problem of providing sufficient live food for frogs after they have reached the adult stage and when kept in small bodies of water, must be solved before intensive frog farming can be counted on as a successful venture, for frogs after transformation from the tadpole form undergo great change in regard to the selection of their food. Larval frogs or tadpoles will thrive on any soft vegetable or animal matter, boiled potatoes, refuse meats, decayed or fresh chicken dressings, while in the adult form or as soon as the legs are fully developed and the tail absorbed, and the young frog is able to perch on a leaf or on a shady bank, he refuses such food, and begins an intensive search for small insects. As he increases in size he snaps at increasingly larger forms of animal life, until in full adult size he will take anything from an insect to a 3-inch fish or a young turtle. The larger frogs are said never to snap at an insect under half an inch in length.

On account of their peculiar feeding habit adult frogs cannot be supplied with a lot of dead fish or raw meat, vegetable refuse, and the like, but must have living food, or food in motion. The Japanese, who for some years have been experimenting in intensive frog culture, have devised a method of giving motion to the grubs, or pupae, of the silk worm, after they have been killed by boiling and the silk unwound from the cocoon. The dead grubs are placed in long, shallow, wooden trays containing about half an inch of water and anchored close to shore; the trays are kept in motion by means of a small water motor which gives the pupae a rolling motion back and forth, and the frogs devour them greedily as long as this motion is maintained. Live food also is placed in these trays--quantities of minnows, young goldfish, crayfish or other small animals easily obtainable, for the frogs are unable to catch the fish in the deeper water of the pond. Small cracks are left in the trays for the water to seep in, and each tray is braced between a raft of four substantial logs arranged so that it will float while holding about half an inch of water. The frogs like to perch on these logs, which at the same time prevent the minnows from escaping.

Strong lights along the shore at night, particularly in the early part of the night, may be used for attracting insects. Two-hundred-watt-non-frosted mazda lamps will attract many June beetles and medium-sized moths. Arc lights will attract even larger insects, sometimes in very large quantities. Flowers and willows should be planted, for various forms of insects are attracted by them. Aquatic plants supply food and harborage for crayfish and tadpoles; and act as oxygenators, and such vegetation as sagittaria is most valuable. Submerged plants such as Potomogeton natans and P. pusillus are valuable in the deeper areas.

EDIBLE SPECIES

In the eastern United States the edible species are the common bullfrog, Rana catesbeiana; the green frog, R. clamitans; the southern bullfrog, R. grylio; leopard frog, R. pipiens; southern leopard frog, R. sphenocephala, and the pickerel frog, R. palustris. In the western States are found the yellow-legged frog R. boylii; the western frog, R. pretio a, and the western bullfrog, R. aurora.

The common bullfrog is the largest North American species, reaching a length of 8 inches measured from tip of nose to end of backbone. It is sometimes referred to as the "Giant bullfrog", and "Jumbo", or "Mammoth Jumbo." The tadpoles, when the hind legs appear, measure 6 to 7 inches from mouth to end of tail. This species ranges from the Gulf coast to southern Canada, and from the Atlantic to the Rocky Mountains. Its

color varies in shades of green and brown; the under parts of both sexes are white with more or less distinct mottlings of brown; the male has a bright yellow throat, while that of the female is dirty white, mottled with brown. The bullfrog may be distinguished from other frogs by the broad flat head; the ear of the male is much larger than the eye, while the ear of the female is about the same size as the eye; a short fold of skin extends backward from the eye over the ear and down to the shoulder; there are no lateral folds, and the hind feet are fully webbed. In stocking ponds with breeders the sexes should be nearly equal in number, as the males usually pair with but one female during a season.

The green frog reaches a length of 3-1/2 to 4 inches; it ranges from the Gulf of Mexico to Hudson Bay; found in practically all of eastern North America.

The southern bullfrog grows to a length of 5 to 6 inches and is known from Florida and some of the other southern States.

The leopard frog, 3-3/4 to 4 inches; range, Sierra Nevada Mountains eastward and from the extreme north to Mexico.

Pickerel frog, length 3 to 3-1/2 inches; found from the central plains to the Atlantic seaboard and from the Gulf of Mexico to Hudson Bay.

Yellow-legged frog, length 2-1/2 to 3-1/2 inches; occurs in California. It has been less used for food because of its skin secretions.

Western frog, length 3 to 4 inches; extends from Nevada and northern California throughout Oregon and Washington to Alberta and east into Montana, Wyoming, and Utah.

Western bullfrog, length 3 to 4 inches; extending from Puget Sound to lower California.

SPAWNING

The bullfrog begins laying eggs in the Gulf States in April and farther north in May or June. The eggs float in a thin sheet at the surface of the water amongst brush or vegetation, and a batch from one female covers about 5 square feet and contains from 10,000 to 25,000 eggs. The size of the egg mass is sufficient criterion for the identification of bullfrog eggs; the eggs of the green frog seldom cover an area of more than a square foot. For stocking purposes the following eggs should be rejected: all that are laid single or in small clusters (tree frogs), or in strings (toads), and all in which the egg mass as a whole is velvety black (leopard frogs). The eggs should be carefully transferred, without breaking the masses, to buckets of water and deposited about the edges of the water to be stocked. A fine-meshed net may be used in handling them. The eggs hatch without care in from 4 days to 3 weeks, varying with the temperature.

GROWTH

The rate of growth of the bullfrog tadpole varies according to climatic conditions; in the Gulf States it never takes more than a year to transform into a frog, and part of the crop may transform in 5 or 6 months, while in the North two years may elapse before transformation takes place, as the growth and development of the tadpole and the young frog depend upon food supply and length of growing season, which in the South is two to three times as long as in the North. In Louisiana bullfrogs have been reared from the transformation state to mature size in two years, but in the North they require a longer time. It is not known how fast they grow in the wild state.

DISEASES

As a rule frogs in a state of nature are not subject to any serious diseases but under crowded conditions in laboratories and small pools they may develop an infection known as "red leg". The only remedies that can be suggested are to remove the infected individuals immediately and, if possible, drain the ponds and let them remain dry for a few days. An article on this infection by Emerson and Norris appeared in the Journal of Experimental Medicine, Vol. 7, 1905, pp. 33-58, published by the Rockefeller Institute of Medical Research, New York City.

The tadpoles breathe by means of gills and are dependent on the oxygen contained in the water; like fishes they will develop diseases when weakened by depletion of the oxygen supply whether from fouling of the water or other causes.

PUBLICATIONS ON FROGS

Cochran, Doris M. - Our Friend the Frog. In National Geographic Magazine, May 1932. (The article gives information life history, etc., with a number of colored illustrations. Published by National Geographic Society, 16th and M Streets, Washington, D. C.)

Dickerson, Mary C. - The Frog Book. (Gives information on habits and life histories of frogs and toads of the northwestern States.) Illus. $5.00 Garden City, N. Y., Doubleday, Page and Co. 1906.
Herriman, M. W. - Commercial Frog Raising. 52 pages. Published, 1933 by the West Coast Frog Industries, No. Hollywood, California, $2.00.
Jarvis, Norman D. - Canning specialty products (frog legs), Fishery Leaflet 86. (Obtainable from the Fish and Wildlife Service, Department of the Interior, Chicago 54, Ill.)
Ruffner, Benjamin M. - Practical Frog Raising. 80 pages. Published January, 1933, by the Southern Frog Farms, Jennings, La., $1.50. (Gives a summary of experiments made in frog culture, with suggestions for practical work in pond construction, etc.)
Storer, Tracy I. - The Eastern Bullfrog in California. In California Fish and Game, Oct., 1922, Vol. 8, No. 4, pp. 219-224. (Published by Board of Fish and Game Commissioners, San Francisco.)
Viosca, Percy, Jr. - Principles of Bullfrog (Rana catesbeiana) culture. 8 pages. Gives an account of Mr. Viosca's frog cultural experiments. It may be obtained at a very reasonable price from the Southern Biological Supply Company, Inc., 517 Decatur Street, New Orleans, La.)
Wright, A. H. - Frogs: Their natural history and utilization. Appendix VI, Report U. S. Bureau of Fisheries, 1919, 44 pages, illus. B. F. Doc. 888. OUT OF PRINT. (Government publications are often available for reference in university and public libraries.)

WHEN FROGS ARE CAUGHT

As frogs hibernate during the winter they cannot be caught then. Most of the fishing is done in early spring and during the spawning season, a very destructive practice, and one which if continued will eventually destroy the industry.

PROTECTIVE REGULATIONS

The several States make their own fishery regulations, and for information on laws governing the frog fishery and interstate shipment of frogs, licenses, or the creation of frog ponds, etc., application should be made to State fishery authorities. The Federal Government has no jurisdiction over such matters. Copies of the State fish and game laws may be obtained from State fishery authorities; a list of these authorities may be obtained from the Bureau of Fisheries on request.

METHODS OF CAPTURE

Several methods for capturing frogs are used by the commercial frog hunters and others, among them being a line baited with red cloth, worms, grasshoppers, etc. Some expert froggers are very adept at catching them alive by hand: a frog catcher will hold one hand over or in front of the frog to attract its attention and capture it by a sudden movement of the other hand. Another method of capture at night is to use a bull's-eye or other form or bright light. The frogs are dazed and in most cases can be caught by hand or approached near enough for their easy dispatch. They are sometimes killed with a gun.

SHIPPING FROGS ALIVE

In shipping frogs alive for stocking or other purposes, they should be packed in shallow crates or boxes, in which they should occupy not more than 50 percent of the floor space. Free circulation of the air is necessary, and damp leaves or moss in moderate quantity should be spread over the floor of the crate and kept moist, throughout the journey. A piece of burlap, or other soft material, may be tacked in the crate, tightly stretched about two inches below the wooden top, to prevent injuries to the frogs as they jump and strike against the top. In winter live frogs should be protected from freezing. As frogs take only living or moving food they cannot be fed when being held for shipment. They can survive a considerable time without food in cold weather, but in warm weather, their time of greatest activity, they cannot be kept for more than a few days without detriment.

KILLING AND SHIPPING FROGS FOR MARKET

In killing frogs for market the head is cut off with a sharp hatchet or a short-handled axe (such as is used in scaling coarse fish at the fish markets). The fingers are then passed between the skin and the body to loosen the skin, and the front legs are slipped out of the skin; by holding the upper portion of the frog, the skin is easily inverted and removed. The entrails are removed and the toes cut off.

From the region of New Orleans most bullfrogs are shipped to market "dressed", which means that the heads are cut off and the entrails removed, and the skin left on. It is believed that a slight musky taste, sometimes discernible in frogs dressed in this manner, is due to the absorption of skin excretions. The best tasting frogs are those from which the skin has been removed in the butchering process, but this may necessitate the packing of individual meats in waxed paper as a sanitary measure and to prevent contact with the ice and consequent wetting and disfiguration. It is probable that better prices from discriminating people might be obtained for frogs dressed and shipped in this manner. Sent to market in the skins, the frogs are shipped in boxes holding 150 or 200 pounds, or barrels holding 200 pounds each. The sizes of frogs sent to market range from the "Jumbo" weighing 10 pounds to the dozen, to the "baby", weighing 2-1/2 to 4 pounds to the dozen. There is also a medium size weighing 8 pounds to the dozen, and a small size weighing 6 pounds to the dozen.